

Mössbauer Spectroscopy of Martian and Sverrefjell Carbonates

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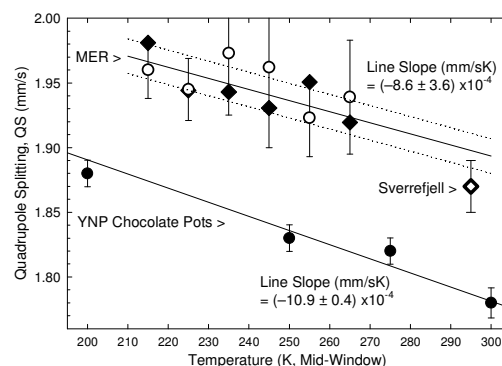
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Mars, in its putative “warmer, wetter” early history, could have had a CO₂ atmosphere much denser than its current value of <10 mbar. The question of where all this early CO₂ has gone has long been debated. Now, several instruments on Mars Exploration Rover (MER) Spirit, including its Mössbauer spectrometer MIMOS II, have identified Mg-Fe carbonate in rock outcrops at Comanche Spur in the Columbia Hills of Gusev Crater [1]. With this finding, carbonate cements in volcanic breccia collected on Sverrefjell Volcano on Spitzbergen Island in the Svalbard Archipelago (Norway) during the AMASE project are mineralogical and possible process analogues of the newly discovered martian carbonate [2, 3].

We report further analyses of Mössbauer spectra from Comanche Spur and discuss their relationship to Mössbauer data acquired on Sverrefjell carbonates. The spectra were velocity calibrated with *MERView* [4] and fit using *MERFit* [5]. Instead of the “average temperature” Comanche spectrum (data from all temperature windows summed [6]), we refit the Comanche data for QS *within each temperature window*, modeling as doublets for Fe²⁺(carbonate), Fe²⁺(olivine), and Fe³⁺(npOx). The temperature dependences of QS for the Comanche carbonate and for a low-Ca carbonate from Chocolate Pots in Yellowstone National Park (YNP) [7] are shown in Figure 1; they are the same within error. For Comanche carbonate summed over 210-270 K, (CS, QS) = (1.23, 1.95) mm/s [1, 6]. The value of QS for Sverrefjell carbonate at 295 K, (CS, QS) = (1.25, 1.87) mm/s [2], is also plotted in Figure 1, and the plot shows that the QS for the Sverrefjell carbonate agrees within error with the Comanche data *extrapolated to 295 K*. This agreement is additional evidence that the Sverrefjell carbonates are Mössbauer analogues for the Comanche carbonates, and that both carbonates might have precipitated from solutions that became carbonate rich by passing through buried carbonate deposits [1].

Figure 1. Carbonate QS values plotted for several samples and analyses: Single-spectrum fits (○, with error bars) and simfit (◆) to Comanche from 210-270 K; Sverrefjell carbonate at 295 K (◇); and YNP carbonate (●). Straight-line fits to simfit Comanche (upper) and YNP (lower) are solid lines. The dotted lines are bounds set by the rms deviation of the Comanche simfit values.



References

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Initial assignment to “Px-C” was reassigned to carbonate (see [1]).
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